E/CONF.39/D/41
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.7.3

United Arab Republic

OTHER ENERGY SOURCES AND REDUCING AGENTS AS SUBSTITUTES FOR COKING COALS IN THE IRON AND STEEL INDUSTRY

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No. 392 D.7.3. OTHER ENERGY SOURCES AND REDUCING AGENTS AS SUBSTITUTES FOR COKING COALS IN THE IRON AND STEEL INDUSTRY

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INTRODUCTION:

1. Thanks to the blast furnace for the role it has played in our modern civilization; however, it does seem that we shall have to bid it farewell soon. Its basic raw material, coke is becoming short and expensive, while other sources of energy and reductants are becoming more and more abundant and getting cheaper all the time. All that remains for the blast furnace to retire is to find a process which can utilize these sources and which is technologically superior. It is the aim of this paper to help towards finding such a process. At the present, this will benefit the less developed areas which have no coking coals but have some of these other sources. In the future it will benefit the whole world.

History and future of iron making:

2. The iron and steel industry has undergone more development than any other industry in the whole history of mankind. This is understandable since iron and steel are almost as essential to man as food and air. It is no wonder then that the extent of civilization of any country can be measured by its consumption per person of these materials.

3. From time immemorial our ancestors first knew about iron when they could shape some pieces of meteorites into useful weapons. In some instances, when making their fires, they found some stones to be converted to a material resembling that of the meteorites and could also be shaped into some of their utilities. They tried to imitate these fires to produce the so called now "Sponge Iron" intentionally from that certain type of stones "Iron Ores" using a crude form of crucible. They found the process to be more efficient when they used charcoal instead of wood. They started to develop the process using their sense of engineering and it was the first furnace for iron production "The Charcoal Forge".

4. Out of these forges, furnaces of larger capacity of the shaft type were developed; but it was only when the height of the shaft was further increased that the reduced iron fused. The process was found to be more efficient when anthracite was used instead of charcoal. However, when coal was carbonized, the product (coke) was found to be the best of all. Further developments until very recently aimed at increasing the productivity of the furnace through increasing its dimensions, improving its design and construction, and blowing hot air instead of cold.

5. Coking coals were thus consumed with increasing amounts and so they are becoming less available and more expensive. Many efforts were made to postpone that day when their use in the iron and steel industry becomes uneconomic and these were

mainly by decreasing the coke consumption in the blast furnace. The ores are now prepared and concentrated before being charged in the furnace; oxygen substitutes part of the air blown into it; the furnace is operated at elevated pressure and with acid burdening ... etc. Furthermore, the coke itself is being in part substituted for in the furnace by other reductants; we know that oil or gaz injection in the furnace is a well established experience now.

6. Of course, it is only comparatively recently that petroleum and natural gas were known and thus could be used in this industry. The same applies to electric power which can already cut down more than a third of the coke consumption in iron making. What would have been the situation of the coke consumption in this industry now should these energy sources and reductants had been known a long time ago; or, in other words, what will be the relative usage of these new sources of energy and reductants with respect to that of coke in the future, and what will be the complete picture of the iron and steel industry after the advent of atomic power which is hoped to produce very cheap electricity in the not so distant future for energy and hydrogen production. If we can, in a sense, extrapolate the past we may be able to visualize the future. Iron will be produced through the gaseous reduction of its ores using electric power as the source of energy.

The position in UAR and some less developed countries:

7. There are some countries for which, having no coking coals it was difficult to establish an iron industry in their lands. The majority ofthese countries have, instead, other sources of energy and reducing agents, an example being the UAR.

8. The position in UAR: In our country we have no coking coals but we have low grade and non-coking varieties which can be gasified. We have also large amounts of waste petroleum gases and in a few years time, a tremendous amount of very cheap electric power which will be available from the High Dam and the Kattara Depression projects. For our good fortune we have iron ore reserves near the sites of these resources. There are three main iron ore bodies in the UAR; at Asswan in Upper Egypt on the River Nile, at El-Bahariya Oasis in the Western desert south of the Kattara Depression and about 200 kilometers west of the Nile, and in the Eastern desert around El-Kouseir on the Red Sea shore.

9. At the first site the High Dam is being erected and it is estimated that one kwh from this project will cost 0.5 millieme at Asswan (equivalent to 1.25 mils). This electric power can be used to produce energy and hydrogen gas for iron smelting. From energy requirements calculations (1) it is estimated that one ton iron requires about 2000 kWh. It also requires 600 cu.m. hydrogen for reduction which consumes 3000 kWh to produce. This makes a total of 5000 kWh which cost £ 2.5. From other economic studies of the project it is estimated that the fixed and running costs for the electrolytic plant per ton iron produced will be about one pound which makes the total cost of power and reductant per ton iron abour £ 3.5. This figure has to be compared with the price of one ton coke (required to produce one ton iron) in Egypt which is about £ 12.5.

10. As will be seen later, the recent trend in steel making is to use oxygen instead of air for blowing. Accordingly, with oxygen as a by-product from the electrolysis the economics of

the iron making will be even more favourable. It has been universally accepted that if the cost of one kWh is less than one fifth of that of one kilogram of coke the use of electricity will be cheaper in iron making. In our case, this will be true if the cost of one kWh is less than 2.5 milliemes which is about 5 times the estimated cost.

11. In case the iron and steel works are erected at Samalout which is the nearest town on the Nile to the Bahariya ore reserves and is about 300 kilometers south of Cairo, the cost of one kWh will rise to one millieme but the works can use both the Asswan and Bahariya ores and the electric power from the High Dam and the Kattara Depression. The cost of energy and reductant will still be lower than in the case of using coke.

12. The oilfields in Egypt are distributed on the Red Sea shore in the Eastern desert and in Sinai. The natural petroleum gas emerging from these fields together with some of that produced from the refineries is now wasted. This gas can be used both as a reductant and for producing electric power, and it has been estimated that the cost of one kWh from this source will be 2.5 milliemes. This power and the gas itself can be used for producing iron from the iron ores of the eastern desert.

13. Big reserves of low grade and non coking coals have been discovered recently in Sinai. These coals cannot be used as they are in the Iron and Steel Industry, but if gasified the produced gases can be used in the same manner as those of petroleum. Some of these coals are deep in the ground and some are near the surface. Underground gasification can be used for the former, while the latter require special gasifying reactors. The gases produced can be transferred to the site of the iron and steel works in a pipe line.

The position in some other parts of the world:

14. Although coal production in Europe was until recently sufficient for its needs, in 1958 the European Economic Organization published a report indicating that by 1965 its countries members will be short in energy resources by a quarter of their needs. Since then studies have been conducted to overcome this difficulty. At the beginning of 1962 a company was been established to build up a net work of pipe lines capable of transporting and distributing the natural gas from the Middle East to different parts in Europe up to the United Kingdom; and to a minimum capacity of ten billion cu.m. of natural gas annually.

15. Does it not stand to reason that the less developed countries of Africa and Asia should turn their attention - with the help of United Nations - to use these resources for building up their industries. Why not extend this net work to them. Huge reserves of natural gases have been discovered recently in North Africa. Similar reserves have been discovered in other parts of Africa and Asia. Why not joining all these reserves with the same and one net work to cover most of the three continents. These gases can provide both power and reductant and it will be thus possible to establish the iron and steel industry on sound and economic bases in any part of this area.

16. What has been said for the old world applies to the two continents of the new world. Every one knows about the huge quantities of natural and petroleum gases which are wasted daily in the different countries of these continents. In Venezuela for instance no less than 17 x 10 (9) cu.m. of high grade natural gas was burnt to waste in 1958; this amount corresponds to

about 22 million tons of high quality coal which can be used to produce at least 15 million tons of iron and steel. This is why we started looking into new iron producing processes which depend upon natural gas as the reducing agent. We looked into the HYL process in Mexico which is the first process to use natural gas in iron production on an industrial scale, and the H-Iron process in the U.S.A. which had just finished its semi-commercial stage.

17. Some countries have no petroleum or natural gases, but they may produce a similar product which can be used for the same purposes. Instead of coking, coals they have low grade and non-coking varieties (including lignites, brown coals, peat etc.) which are of little value, but when gasified they can be used in the iron and steel industry as mentioned above. Examples of such countries are Argentina, Malaya, Thailand, and Greece. But even in countries having coking coals, as the mines grow deeper the extraction becomes more expensive and underground gasification may be the solution to the problem.

18. When the second World War ended all countries, specially the less developed, started to industrialize. Industrialization depends mainly on the availability of cheap electric power. Burning of cheap fuels is one way of achieving this, but cheaper electricity may be produced from dams, natural water falls etc.; the High Dam being e recent example, and Niagara falls being an older one. Very recently, the Russians announced that by 1980 the electric power produced in the Soviet Union will be three times that produced in the U.S.A. now, and that half of this power will be produced by hydro-electric means. African and Asian countries are in a race to make all the benefit they can from the water power available in their lands. We have all heard about the Volta scheme in Ghana the Konakry scheme in Guinea, the Inga scheme in the Congo, and we already know about the Owen falls scheme in Uganda. In Asia similar schemes were installed in Pakistan, in India, in Turkey .... etc. In some countries most of its electricity is produced by hydro-electric means. For example, in Morocco, in Ceylon, and in Brazil about 80% of the electric power is produced by this means.

19. Many of us may have heard of that gigantic project of producing electricity from a huge dam built at the southern opening of the Red Sea. The idea is based on the fact that the rate of evaporation from the Red Sea is higher than that from the Indian Ocean. Accordingly, if the Red Sea is closed for a certain period of time the water level in it will become lower than that in the Indian Ocean and this water head can be kept constant forever according to the rate of discharge from the ocean into the sea. Such head can be used to produce hydro-electric power. If this dream is realized, all the African and Asian countries around this point will have available to them a huge amount of very cheap electricity which will help their industrialization.

20. Naturally, each country has to follow the cheapest way, consistent with its own circumstances to produce its electricity. It may be cheaper for some countries to use coal or petroleum products than to install hydro-electric power stations. But it seems that by the end of this century, or a bit later, electricity production through out the world will be either by hydro-electric means, or through the use of atomic energy. The cost of production will be much lower than it is today and consequently all power requirements will be provided through electricity; and it may be for the good luck of mankind that when natural fuels became short God provided him with better substitutes.

Electricity and reducing gases versus coke:

21. It is not only that coking coals are becoming short and their substitutes are becoming available, but these substitutes are much better than coke from all points of view and should they have been known to our ancestors coke may have never been used in the iron and steel industry.

22. The advantages can be summarized in the following:

(a) The use of electricity as a source of energy is cleaner, simpler, and easier to control than the use of other sources of energy. It can be used also for the production of hydrogen, the master of all reductants and which is a main constituents of most reductants.

(b) Hydrogen is a more powerful reducing agent than carbon or carbon monoxide; the reduction is quicker and more efficient. It does not add impurities to the metal as does coke, on the contrary it washes out any sulphur and removes a considerable part of the phosphorus. Manganese and silicon hardly enter the metal. This means that the iron produced will be practically pure, and with some ladle additions it might be possible to convert it directly to steel. In the worst case the conversion process will be less wasteful in time, effort and expenses

(c) Handling of gases is simpler than handling of solids. The gases being free of gangue material the process requires less flux and consequently less energy. The slag volume will decrease and consequently the productivity increases or lower grade ores can be used with the same power consumption and the same productive capacity. This enables the use of low grade ores which are difficult to concentrate.

(d) Sulphur being no problem the process can be acidic with all the advantages of acid smelting.

(e) When hydrogen is produced electrolytically oxygen is produced as a by-product. The recent trend in converting iron to steel is to use oxygen instead of air; the process is more efficient and the steel is of a better quality. Oxygen is prepared now intentionally for this purpose.

23. In the blast furnace the ore is charged in the lump form. However, fine ore is becoming more abundant than lump ore and it has to be agglomerated to suit the blast furnace. The sources of fine ores are numerous some ores are found in nature in the fine state, soft and friable ores have to be ground fine and re-agglomerated before being used in the blast furnace, during size preparation of the furnace charge a lot of fines is produced, Through the passing centuries much of the high grade ores was consumed and we are left with the low grade ores which are uneconomic to be used as they are in the blast furnace and have to be concentrated before being charged into it. For concentration they have to be ground fine.

24. From this, one can see that in the near future most of the ores will, for one reason or another, pass through a stage in which they will be in the fine state. It seems quite illogical to waste effort, time and money to agglomerate them just to suit the existing blast furnace process; particularly if we consider the fact that handling of fine materials using the new techniques is simpler than handling lump ores; and equally true, the rate of reduction of fine ores is much higher than that of lump ores. So,

in trying to develop a process that can use gaseous reductants and electric power instead of coke we might as well adapt it to use fine ore instead of lump ore.

Research work:

25. Research work already carried out: Due to these special circumstances of the UAR as to the shortage of coking coals and availability of other sources of energy and reductants, and because of the advantages of these other sources over coke, a research program has been set up since 1949 which aims at finding out a process that can use these sources for iron production.

26. The first work (2) was a study of the reducibility of Egyptian iron ores with hydrogen, petroleum gas, and reformed petroleum gas. The reduction was found to be very quick and most efficient with hydrogen. The petroleum gas required a special technique so that it can be used. The rate of reduction with the reformed gas was proportional to its hydrogen content. The reduction was conducted in an ordinary tube furnace arrangement.

27. In an attempt to increase the rate of reduction the catalytic effect of about one hundred compounds was studied (3). Platinum, nickel and copper compounds catalysed the reaction but only at the low temperatures where the reaction was ordinarily very slow. Above 500°C there was no effect at all. This work was considered as of no industrial value and no further attempt was done in this direction.

28. Since the rate of reaction between a solid and a gas increases with the increase in the surface area of the solid and the decrease in the diffusion path both of which can be achieved by decreasing the particle size of the solid material, the ore was reduced in the fine state. To ensure the exposure of all the particles surface to the reducing effect of the gas they were made to fall through an ascending stream of the gas in a vertical tube 8 metres high which was electrically heated. From the results of this work it was possible to establish the main features of the required process and a patent was registered at the Egyptian patent office in January 1954 (4).

29. For this process to be applied industrially the scientific and technological aspects of the process have to be thoroughly understood, and this was the aim of the research work conducted since then.

30. In the following work (5) a comprehensive study was made of the characteristics of particles and particulate systems and their behaviour when combined with a gas. The effect of temperature on the terminal falling velocity of particles in gases was formulated taking into consideration the properties of both solids and gases.

31. To study the effect on reduction of the different variables that will affect the efficiency of the process a conical silica tube was constructed so that when hydrogen is streaming upward through it at the temperature range studied its velocity will be such that the fine particles will be suspended at some position in it. The two variables that have major effect are temperature and gas/ore ratio; the rate of reduction increases by their increase and the reduction is complete in a few seconds (6). Particle and ore characteristics have a small effect which even practically vanishes at temperatures above 800°C. This result differs from what is known about the reduction of lump ores, namely, that ore and lump characteristics have a major effect on the reduction.

32. The same conclusions were arrived at when the ores were reduced in the fluidized state (7). Due to the small gas/ore ratio in this case the rate of reduction is practically directly proportional to its value. It was not possible to complete the reduction in the fluidized state at the elevated temperature used in this study. At a certain percentage of reduction which was termed the sintering point the particles stick together and fluidization stops. The sintering point was higher the lower the temperature, the bigger the particle size and the higher the gas velocity. Sintering, could be retarded by covering the particles with any of certain materials.

33. In a trial to find out how a single particle is reduced while being suspended in the reducing gas a small net of nichrome wire was made and it was possible to put small single particles in it and subject them to all the conditions of the preceding studies. The reduction propagation into the particles was studied under the microscope and the rate of reduction of a single particle could be estimated (8). By the end of this part of work it was considered that the basic studies concerning this project has been completed. However, some further studies are still essential.

34. Research work going on: A big fluidization unit made of stainless steel was constructed to study the effect of scaling up the unit and the effect of particle distribution on the rate of elutriation from the bed and the effect of self-agglomeration on decreasing this tendency. This unit will be used also in solving some of the problems that will arise during the pilot plant experimentation stage, and is particularly arranged for studying the material and heat balances in the different parts of the pilot furnace.

35. Another study concerns the effect of hydrogen on the impurities in iron ores. The results arrived at so far indicate that hydrogen removes all the sulphur if present as pyrite. It can remove a considerable part of the phosphorus especially when silica is also present.

36. Since, as will be seen later, heat has to be supplied in some parts of the furnace, and since this can be achieved by injecting oxygen at these parts, a study is being conducted to harness the reaction between oxygen and hydrogen in presence of reduced iron so that the liability of any explosion can be avoided.

37. During the work on a semi pilot model of the furnace some difficulties were encountered as to the flow of particles through the downcomers. A study has been started to overcome these difficulties.

38. The iron produced from reduction is in a sponge form and contains all the gangue material in the ore. The next and fifth phase of study concerns the smelting of this sponge iron with a flux to produce iron and slag. Different basisities were used and the iron produced was very low in manganese and silicon.

39. The next phase concerns the purification of the produced iron by oxygen blowing. No quantitative results have yet been obtained, but the removal of phosphorus was efficient.

40. Coal was recently discovered in UAR but the varieties found are non-coking and of low grade. A study is being conducted to gasify these coals to produce a gas that consists mainly of hydrogen and carbon monoxide.

41. The pilot plant stage: The work going on now is a study, using a prespex model of the furnace, of the flow pattern of solids against the upstreaming gas. A semi pilot furnace which is identical to the model, 15 cms. diameter, and consisting of many separate sections that can be bolted together, has been constructed of stainless steel. Sponge iron produced from this furnace will be smelted in a separate electric arc furnace. The productive capacity of the semi pilot furnace is about 100 kg/hr.

42. The pilot scale furnace, the equipment of which has been ordered, is 60 cms. diameter and has a productive capacity of about 2 tons/hr. The reduced iron will fall directly into the electric furnace beneath the shaft and molten iron and slag will be tapped out of the furnace. Hydrogen gas will be produced electrolytically; the electrolytic cell has been erected and tested. The gas holders are being constructed as well as the other parts of the plant.

The electrogen furnace process for iron production:

43. The principles of this proces is based upon using gaseous reductants to produce pure molten iron from fine ores using electric power as the source of energy. It is a flexible, continuous, efficient process that can use any type of grade of ore.

44. The furnace consists mainly of three parts, the top, the shaft and the hearth. The top consists of consecutive perforated trays on which the ore is dried, preheated, and partially reduced in the fluidized state. The ore descends from one tray to another through downcomers and from the lower tray into the shaft through a specially designed small fluidization unit which acts as a gas seal. The tray diameter depends upon the productive capacity of the furnace where as the number of trays depends upon the reducibility of the ore, its sintering point, and the reducing conditions inside the furnace (7). When changing from one ore to another, the only alteration will be in the fluidized bed height on the trays.

45. The partially reduced ore falls from the lower tray into the top of the shaft and by the time it reaches the hearth it will be mostly reduced. The shaft diameter depends upon the productive capacity of the furnace where as its height depends upon the ore reducibility, sintering point, and particles' characteristics (6).

46. The capacity of the electric arc furnace (the hearth) is designed according to the productive capacity of the furnace as a whole, while the energy input is designed to provide the heat requirements.

47. For the operation the ore comes to the furnace top by any means of conveying fine material, and is charged to the top tray through a star valve that prevents gas leakage. The ore is dried and preheated by exchanging heat with the waste gaz coming up. Oxygen is injected in the second tray to bring up the ore temperature to about 900°C. In the following trays the ore will be reduced by the hydrogen flowing through it. However, the extent of reduction in the bottom tray should not exceed the sintering point, and the material has to fall into the shaft before the reduction reaches this point (7). In fact, this is the most critical stage in the whole operation. If the ore falls down before the percentage reduction approaches the sintering point it will reach the hearth partially unreduced which causes a loss in production. If on the other hand the sintering point is attained fluidization

will stop and consequently the whole operation comes to standstill. Equally, if not more troublesome, problems are encountered in blast furnace operation, and, of course, in the pilot plant stage such problems will be solved and measures will be taken to allow smooth operation.

48. Suppose the sintering point of the ore used under the prevailing conditions is 85%, then the ore has to leave the bottom tray at about 80% reduction. Most of the remaining 20% oxygen has to be removed in the time the particles take to fall from the top to the bottom of the shaft. This time depends upon the terminal falling velocity of the particles and the velocity of the upstreaming gas, and accordingly can be controlled to suit the reduction characteristics of the ore (5,6).

49. Any iron oxide remaining in the ore is reduced by the hot 100% hydrogen gas entering the hearth through the tuyeres around it (2). By the addition of flux molten iron and slag are formed. The flux can be introduced by any of two ways. Either by adding it to the ore from the top, or by blowing it with the gas from the bottom; both methods will be experimented with in the pilot plant stage.

50. The gas is preheated before entering the furnace, first, by exchanging heat with the gases coming out of the furnace top, and then by electric means. It enters the hearth through the tuyeres, carrying with it extra heat from the arc furnace and goes up through the shaft and fluidized beds to achieve reduction and to convey the required heat to the system. The gas passing through the furnace is three times that theoretically required for reduction and this is to increase its reduction potential, to convey all the heat requirements to the shaft and top of the furnace, and to enable the use of bigger particles which results in a decrease in the flue dust amount and an increase in the sintering point. As it comes out of the furnace the gases pass through condensers and heat exchangers where by the formed water condenses and the cooled hydrogen is recirculated after adding the hydrogen balance to it.

The electrogen process versus other new processes of iron production:

51. The new processes of iron production can be classified into three main groups:

(a) Those that reduce lump or agglomerated ore in a shaft furnace type or in a fixed bed; examples of which are the Wiberg and the HYL processes.

(b) Those that reduce fine ore in the fluidized state as the H-Iron and Esso-Little processes.

(c) Those that reduce fine ore in a rotary kiln as the Krupp-Renn and Stratigic Udy processes.

52. The first two categories can work only on very rich or highly concentrated ores since they achieve reduction only and not smelting; the product is then charged directly in steel furnaces. However for a process to compete with the blast furnace it should be able to treat any type or grade of ore; and since the separation of the smelting operation from that of reduction costs about 200 - 400 kWh per ton of iron, the two operations must be achieved in the same and one unit if the process is to be economic.

53. The third category can treat any ore since the ore is smelted in either the kiln itself or in an attached electric furnace. But it is a well known fact that just about the worst conditions for heat and mass transfer between a gas and a solid are those existing in a rotary kiln system which means that the process is far from being efficient. This fact coupled with the complexity of the operation rules out this category as being able to replace the blast furnace.

54. From what has been said in paragraphs 3 and 4 the process of the future has to work with gaseous reductants and fine ores. Since the fluidization phenomenon gives the best heat and mass transfer between gases and solids a process based on fluidization will be very efficient. If it is possible to achieve reduction and smelting in the same unit and to use electirc power as the source of energy we will have arrived at the ideal process for our purpose, which leads to the Electrogen Furnace process.

International cooperation in this field:

55. Although the electrogen furnace process is now in the pilot plant stage it can still accept any modification or improvement that makes it more reliable. We invite, through the United Nations, all experts in this field to help us in developing this process and we particularly note those of the U.S.A. due to their long experience in this field.

56. As to our neighbours and friends in the less developed areas, which have similar circumstances as we have, we invite them to collaborate with us in developing this process, to send their representatives to take part in the research work conducted, and to be present in the pilot plant experimentation stage. Also to discuss with us and with the world experts in this field the possibility of applying this process in their countries, with whatever modifications as may be necessary to suit most their particular circumstances.

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392 E - Oct. 1962 - 1,600

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SUMMARY

INTRODUCTION:

Due to the fact that coking coals are becoming short and expensive while other sources of energy and reductants are becoming more abundant and cheaper, it is the aim of this paper to help towards finding a process that can use these sources and substitute the blast furnace. At the present, this will benefit the less developed areas but in the future it may benefit the whole world.

History and future of iron making:

From a survey of the history of iron making and its present state one can visualize its future. Iron will be produced through the gaseous reduction of fine iron ores using electric power as the source of energy. It is expected that in the not so distant future, electricity produced fron water and atomic power will be the cheapest source of energy.

The position in UAR and some less developed countries:

There are some countries for which, having no coking coals it was difficult to establish an iron industry in their lands. The majority of these countries have, instead, other sources of energy and reducing agents, an example being the UAR.

(a) The position in UAR: In our country we have no coking coals, but we have low grade and non-coking varieties which can be gasified to produce a gas that can be used as a cheap fuel for electric power production, and as a gaseous reductant. We have also large amounts of waste petroleum gases which can be used for the same purposes with a cost competitive with that of coke. In the near future a tremendous amount of very cheap electric power will be available from the High Dam and the Kattara Depression projects. For our good fortune we have big iron ore reserves near the sites of these resources. If, for example, the electric power from the High Dam is used for hydrogen and energy production the cost of power and reductant per ton iron produced will be £ 3.5 which has to be compared with 12.5, the price of one ton coke in Egypt.

(b) The position in some other parts of the world: Huge reserves of natural and petroleum gases are found in the Middle East and some other parts of Asia and Africa. These reserves can be joined together by a net work of pipe lines which distributes the gas to the different countries of these continents; and through the help of the United Nations they can build up economic industries. Many countries contain non-coking and low grade coals which can be converted to useful gases by under-ground gasification or otherwise. All countries are trying to produce cheap electric power to help industrialization; cheap fuels and hydro-electric means are used while atomic power is coming into the picture.

Electricity and reducing gases versus coke:

Coke substitutes have the following advantages over coke:

(a) The use of electricity is cleaner and simpler than the use of coke. It can be used for hydrogen production.

(b) Hydrogen is the most powerful reductant; by using it the metal produced will be much cleaner than when using coke.

(c) When using gases less flux is required and consequently less energy; productivity increases and lower grade ores can be used.

(d) The process can be run acidic which is advantageous.

(e) Oxygen produced, as a by-product, electrolytically during hydrogen preparation, can be used in the steel industry.

Research work:

(a) Research work already carried out: The basic studies concerning this project were done in seven works during the period 1949 - 1959.

(b) Research work going on: Three works deal with the technological aspects of the process while the other four concern the production of pure iron and steel from the reduced sponge.

(c) The pilot plant stage: Work is being conducted on semi-pilot units while arrangements for the pilot stage are nearly complete.

The electrogen furnace process for iron production:

The principle of this process is based upon using gaseous reductants to produce molten iron from fine ores using electric power as the source of energy. It is a flexible, continuous, efficient process that can use any type or grade of ore. The furnace consists of three parts; the top where the ore is charged, dried, preheated, and partially reduced; the shaft where the reduction is almost complete by the time the particles fall from its top to its bottom; and the hearth where the reduced particles are smelted with the help of a flux to produce molten iron and slag. The hearth is an electric arc furnace.

The electrogen process versus other new processes of iron production:

After surveying the other new processes of iron production and their principles, a comparison was made between these processes and the electrogen process which showed, on scientific, technological and economic basis, the latter process to be the most reliable of all and even to be a strong contestant to the blast furnace process.

International cooperation in this field:

We invite, through the United Nations, all experts in this field to help us in the further development of this process, and we invite our neighbours and friends in the less developed areas to collaborate with us in the research work and pilot plant stage going on and to discuss with us the best way in our particular circumstances for developing the iron and steel industry in our countries.

S - 392 E - Oct.1962 - 1,600

E/CONF.39/D/42
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.13

United Arab Republic

LOCAL RAW MATERIALS IN THE PRODUCTION OF GLASS, BRICKS AND TILES IN U.A.R.

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LOCAL RAW MATERIALS IN THE PRODUCTION OF GLASS, BRICKS AND TILES IN U.A.R.

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and

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PART I. GLASS

INTRODUCTION:

1. The modern glass industry started in Egypt in 1932 when a small facotry started melting glass from its raw materials and such articles as lamp chimneys, tableware and medicine bottles were manufactured manually.

2. In 1952, the glass industry in Egypt was partly automized and nowadays bottles, tableware and sheet glass are produced by almost fully automatic production units. The yearly production of glass in Egypt is about 50,000 tons and is expected to increase to 100,000 tons/year in 1970. The new projects include the production ground and polished plate glass, coloured glass for bottles and jars, borosilicate glass and lead oxide containing glass for optical and decorative (crystal) purposes.

The progressive increase in the production of glass and the necessity for improvement of the quality since 1952 was met through the progress in applied and development research which was carried out, mainly in the glass-research unit of the National Research Centre and partly in the glass factories. These investigations included studies on the possible use of local raw materials, improvement of the melting techniques and the choice of the most suitable batches for the different varieties of glass produced.

RAW MATERIALS

Sand:

4. Before 1955, all sands used for glass making were imported from France, Belgium and Holland. In the study of the possible use of local sands, it was necessary to divide the sands into three types, namely -

(a) Sands suitable for the manufacture of white colourless glass for tableware and bottles: The sand deposits in Syna desert at about 150 kilometres from Suez were found suitable for this purpose. The chemical analysis of a number of samples taken from different parts of these deposits showed that:

SiO_2	content ranges from	98	to 99%
Fe_2O_3	" " "	0.03	to 0.05%
Al_2O_3	content is about	1.0%	
CaO	" " "	0.4%	

The particle size is mostly between 0.1 mm and 1 mm in diameter. Occasionally some parts of the sand deposit showed more fines (less than 0.1 mm in diameter) than would be required. This was usually associated with a high iron oxide content (about 0.05% Fe_2O_3). Washing with water in specially designed continuous washers eliminated the greatest part of the fine particles and reduced the Fe_2O_3 content to 0.03%.

The manufacture of all the white colourless glass for bottles and tableware is now made from this sand of which about 10,000 tons are used per year. This figure is expected to be doubled in 1970. The deposits of sand in Syna contain over one million tons.

(b) Sands suitable for making sheet, plate and rolled plate glass: The sand deposit in Maadi Desert, about 20 kilometres from the centre of Cairo, was investigated. The raw sand is inhomogenious containing a considerable proportion of aluminous clay (6 to 8%). The particles vary in diameter between 0.05 mm and 3 mm., and are irregular in shape. The silica content varies from 94 to 96% and the iron content (as Fe_2O_3) varies from 0.3 to 0:64. It was found, however, that by careful selection of the white sand varieties and partial sieving to remove the coarse particles at the sand deposit in the desert followed by washing with water and sieving, sands of a more or less consistent chemical and physical compositions could be obtained. The resulting sand contained about 96.5% SiO_2, 0.15% Fe_2O_3 and 2.0% Al_2O_3 and the particles had diameters between 0.1 and 0.6 mm.

In 1961, about 13,000 tons of this processed sand were prepared at a cost of about 30% the cost of imported sands and were used in the manufacture of 18,000 tons of sheet and rolled-plate cathedral glass. It is expected that 30,000 tons of this sand will be used in 1970 for the manufacture of about 40,000 tons of sheet, plate and rolled plate glass.

(c) Sands suitable for making coloured glass. Samples from the sand in the deserts around Cairo, between Cairo and Alexandria and between Cairo and Suez have been investigated. They all showed a high iron content, from 0.5 to 1% Fe_2O_3, and a silica content of 94 to 97%. The particle size is also variable ranging from 0.01 to 3 mm in diameter but in all cases it was found possible to sieve

the sand manually or automatically giving the particles of the required size (from 0.2 to 0.6 mm diameter).

Experimental meltings showed that these sands are suitable for manufacturing green and brown glass for such articles as beer bottles and margarine jars.

For the manufacture of the fine quality of coloured tableware glass of the blue, red, yellow and similar colours, a sand of a lower iron content than these sands will be required. The washed and sieved Maadi sand is suitable for this purpose.

As a result of these findings, El Nasr Glass Company in Cairo is planning the production of about 12,000 tons/year of green and brown glass for bottles and jars. A site as near as possible to the sand deposit is now under-choice where a new factory is expected to start this production in 1964. It is expected that by 1970 the production will be double this quantity. The same Company is also planning the production of about 1000 tons of coloured tableware glass in small day tanks which is expected to start in 1964.

Sources of alkalis:

(a) The greatest part of the alkalis used in the glass manufacture is Na_2O which is mainly introduced in the form of imported sodium carbonate. The introduction of up to 20% of the Na_2O required for glass in the form of sodium sulphate, which is obtained as a by-product in the rayon industry is a possibility.

(b) Local felspars containing up to 10% (Na_2O + K_2O) are also possible sources of alkalis as well as alumina.

(c) Natron, from the well-known Natron Valley, has been the subject of an extensive investigation from which it was realized that some of the lakes are rich in their Na_2CO_3 content although most of the lakes contain mixtures of Na_2CO_3, Na_2SO_4 and NaCl. The presence of a high proportion of NaCl in these mixtures limits their use in the glass industry but experimental meltings proved that it is possible to introduce up to 40% of the alkalis in coloured green and brown glass in the form of natron while only 20% of the alkalis in sheet glass can be introduced in the form of the Na_2CO_3 - rich natron deposits.

6. Sources of lime and magnesia:

(a) The calcium carbonate in Upper Egypt, at about 200 kilometres south Cairo, is of the pure chalk quality containing about 99.5% $CaCO_3$ and not more than 0.01% Fe_2O_3 which makes it an excellent source of CaO in the manufacture of the best quality white colourless glass.

(b) The limestones of Tourah (20 kilometres from the centre of Cairo) and Helwan (40 kilometres from the centre of Cairo) contain about 98.C% $CaCO_3$ and 0.05 to 0.1% Fe_2O_3 and they can be used in the manufacture of sheet, plate, rolled-plate and coloured glass.

(c) Iron slags from the blast-furnaces can be used as sources of CaO and Fe_2O_3 in the manufacture of green and brown bottles.

(d) The magnesia is mostly introduced in the form of dolomite from Attaka near Suez which contains about 29% CaO, 18% MgO and 0.1% Fe_2O_3. The high iron content limits its use to the sheet, plate, rolled-plate and coloured glass.

(e) The recent discovery of magnesite near El Kouseir which contains about 97% $MgCO_3$ and 0.04% Fe_2O_3 is expected to enable the replacement of the present imported low-iron dolomite for the production of white colourless glass.

Batches:

7. The development of new batches to suit our local raw materials and to suit our requirements of better glass quality may be quoted as examples.

In the production of sheet glass (Fourcault process) the following ranges of glass composition can be used:

SiO_2	from	71	to	72.5%
Al_2O_3	"	0.5	to	1.5%
CaO	"	6.5	to	7.5%
MgO	"	2.8	to	3.1%
Na_2O	"	14.5	to	15.5%
SO_3	about	0.5%		

8. The rolled plate glass can be made from the following glass composition:

SiO_2	from	72.0	to	74%
Al_2O_3	"	1.0	to	2.0%
CaO	"	7.5	to	8.5%
MgO	"	1.5	to	2.0%
Na_2O	"	14	to	15%
SO_3	about	0.5%		

9. When the total requirements of both sheet and rolled plate glass do not justify the production of these two types of glass each in one separate furnace, it is recommended that a glass of the following composition would suit the two types of glass:

SiO_2	72.5%
Al_2O_3	1.5%
CaO	7.2%
MgO	2.8%
Na_2O	15.5%
SO_3	0.5%
	100.0%

10. Part of the horizontally drawn glass can be drawn plain followed by grinding and polishing thus giving plate glass.

11. In the manufacture of white colourless tableware and bottles, our experience indicates the possible use of one glass composition, namely,

SiO_2	72.5%
Al_2O_3	1.5%
CaO	8.5%
MgO	2.0%
Na_2O	15.5%
	100.0%

PART II. BRICKS AND TILES

Introduction:

12. In Egypt, the brick making is one of the oldest arts known. The oldest bricks found are of pre-dynastic date of Sakkara and Abydos in the tombs of the first and second dynasty.

13. The brick manufacture in Egypt up till now, is depending on the Nile silt, which is a mixture of clay (Illite mineral) and sand, containing variable amounts of impurities. The constitution of the Nile silt varies greatly from year to year and from place to place, and such non homogenity accounts for the difficulties in producing a good building brick.

14. For acquiring the necessary raw material for brick making silting basins are chosen near the brick factories, at the banks of the Nile. The Nile flood-water, tarbid with silt, is allowed to flow in and out the basin precipitating the silt en route. The rate and type of silt deposition depends on the shape, grain size, specific gravity of the constituting materials as well as velocity of the current and the design of the silting basins. It is therefore evident that the silting basin contains a varied mixture of sandy silt, silt and mud. Due to these conditions the brick industry became a matter of individual practice and no technological help could be given. This accounts for the poor quality building bricks produced.

15. After the construction of the High Dam at Asswan, the major part of the silt will be deposited behind the dam and its amount would be naturally less. Also its grain size and concentration, coming to Egypt, would be small and accordingly the quantity of silt deposition in the brick factories basins would be hardly enough to suffice the eight million tons of silt they need every year.

16. New natural raw materials of clay and sand to replace the Nile silt would be the welcomed answer to such a national problem facing the brick industry in the UAR. The present requirements of eight million tons of clay per year would naturally be doubled to meet the new building development schemes in the UAR five year plan.

Clay deposits:

17. Huge deposits of natural clays are found and geologically sampled from different localities of the UAR, Syria and Lybia. In UAR workable clay beds are found in the Mokkattam Hills boardering Cairo, at Tebbyne 40 kilometres from Cairo, at Abou // Menya in Upper Egypt. In other Arab Countries: Syrian, clays are found at Zabadanis and the Libyan clays at the Gerian locality.

18. The workability of these clays are found to be good and suitable for ordinary hand moulding as well as mechanical forming. Mineralogically speaking they belong/the clay mineral /to group Illite, the same type of mineral the Nile silt contains. Beside the mineral Illite they contain varying amounts of free silica or quartz sand, mainly required in mixes of brick production.

19. The chemical constitution reveals that these clays contain appreciable amounts of iron oxide which is responsible for the different pattern of yellow, orange and red colour the bricks show when fired. They contain fair amounts of fluxes which would help their vitrification at a reasonable low firing temperature and therefore would cut their firing production costs.

Brick and tile making:

20. In the light of physical characteristics of the clays, their mineral and chemical constitution and their thermochemical behaviour when heated - sample briquettes were formed. Perforated bricks and tiles were processed by varying means of mechanical brick making machines. Samples were formed using the ordinary extrusion method without passing the mix between the rollers. Another set of samples were prepared by passing the mix between the double rollers before extruding. A third set of samples were prepared using the extrusion method combined with the dearing mechanism but without passing the mix through the rollers. The fourth set of samples were prepared by passing the mix through the double rollers and using the extrusion method combined with the dearing mechanism, This was applied on different mixes of clay and sand, the latter being added to the clay in amounts ranging between 10 to 50% by weight.

21. The different series of samples formed were subjected to varying conditions of natural and artificial drying and their drying behaviour followed. The dried samples are then fired at 700, 800, 900 and 1000 degree centigrade under different rates of firing. This enabled us to determine the suitable mixes and the proper conditions of drying and firing such mixes. The selected successful batches and their fired products are tested to examine their physical and mechanical properties, as shown in Table I and Table II.

22. It is evident from these results that the extension method of forming combined with dearing would produce a stronger dense type of perforated building unit. It is, however, interesting to note the wide variation in strength when the samples of the perforated bricks are tested in the crushing strength test at

// Rawash near Cairo, at the Kharga Oasis in the western desert, and at

position 1, 2 and 3 as shown in Fig. I. Position 1 showed the highest strength followed by position 2, followed by position 3 which showed the lowest strength as shown in Table II. This is mainly due to the effective bearing are a (gross area) in the three positions the load was applied on. Such results may indicate the possibility of using such units in bearing well construction.

Low cost houses:

23. The cost of the perforated building units have been calculated from actually producing industrially half a million of these units. The cost of one thousand units size 25x12x13 cms was found to be seven Egyptian Pounds which is about the same cost of similar volume of the ordinary common red brick produced in UAR.

24. Accordingly extensive studies have been made to put the technological and economical project for small mechanical building plants to be established in different parts of the UAR. Each plant would produce 10 millions perforated units size 25 x 12 x 13 cms, for walls 2 millions perforated units size 50 x 25 x 10 cms for roofs. The cost of the complete factory would amount to about 150,000 Egyptian pounds. The factories are to be erected near the sites where the clay and sand occur. The UAR would need to erect about 100 of these factories in order to meet the increasing demand of building bricks needed for the huge building schemes in the coming five years. Some of these factories are about to be erected in Kharga Oasis where building construction are being hindered by the high cost of transportation.

25. The flexibility of the extrusion type of machines in these factories would enable the production of various shapes of perforated units for walls, roofs and floors cutting the cost of present construction by 25%.

26. A new design for a low cost farmer's house Fig. 2, has been claimed. The use of the perforated units in such houses would lower considerably the final cost. Fixed furniture in the design are shown.

TABLE I

Composition		Firing Temperature 700°C.					
		Extrusion Only			Extrusion qnd Deqiring		
Clay	Sand	Bulk Density	Porosity	Water Absorption	Bulk Density	Porosity	Water Absorption
100	0	1.24	25.33	13.10	1.28	24.54	12.30
90	10	1.25	25.46	13.12	1.28	24.65	12.44
80	20	1.27	25.60	13.22	1.32	24.88	12.56
70	30	1.29	25.80	13.30	1.32	24.91	12.60
60	40	1.29	27.65	14.61	1.32	27.00	14.10
50	50	1.26	29.50	15.77	1.29	29.31	15.45

Composition		Firing Temperature 800°C.					
		Extrusion Only			Extrusion and Deairing		
Clay	Sand	Bulk Density	Porosity	Water Absorption	Bulk Density	Porosity	Water Absorption
100	0	1.22	25.00	12.45	1.26	23.70	11.97
90	10	1.23	25.00	12.50	1.28	24.65	12.15
80	20	1.25	25.54	13.19	1.28	24.44	12.53
70	30	1.27	25.60	13.25	1.28	24.50	12.60
60	40	1.29	27.42	14.40	1.32	26.70	13.90
50	50	1.252	29.20	15.50	1.26	29.00	15.25

TABLE II

Composition		Crushing Strength in Kg./cm.^{2} at Position 1			
		Extrusion Only		Extrusion and Deairing	
Clay	Sand	Fired at 700°C	Fired at 800°C	Fired at 700°C	Fired at 800°C
100	0	207	310	253	322
90	10	160	230	170	279
80	20	146	153	159	170
70	30	105	141	144	160
60	40	84	102	105	142
50	50	60	69	75	80

Composition		Crushing Strength in Kg./cm.^{2} at Position 1			
		Rollers and Extrusion		Rollers, Extrusion and Deairing	
Clay	Sand	Fired at 700°C	Fired at 800°C	Fired at 700°C	Fired at 800°C
100	0	223	300	230	340
90	10	168	187	191	240
80	20	150	160	168	172
70	30	112	140	145	160
60	40	91	92	94	140
50	50	60	64	66	72

TABLE III

Composition		Firing Temperature 900°C - C.S in Kg./cm^2.					
		Extrusion Only			Extrusion and Deairing		
Clay	Sand	Position 1	Position 2	Position 3	Position 1	Position 2	Position 3
100	0	370	150	73	640	193	80
90	10	294	91	40	397	106	51
80	20	270	81	32	274	101	46
70	30	183	76	30	189	85	41
60	40	121	66	25	166	70	33
50	50	86	49	23	80	50	27
Composition		Firing Temperature 1000°C. - C.S in Kg./cm^2.					
		Extrusion Only			Extrusion and Deairing		
Clay	Sand	Position 1	Position 2	Position 3	Position 1	Position 2	Position 3
100	0	557	156	100	721	256	105
90	10	463	126	59	457	145	67
80	20	290	95	44	302	122	50
70	30	193	90	41	256	102	45
60	40	154	71	26	192	80	36
50	50	91	52	24	100	55	32

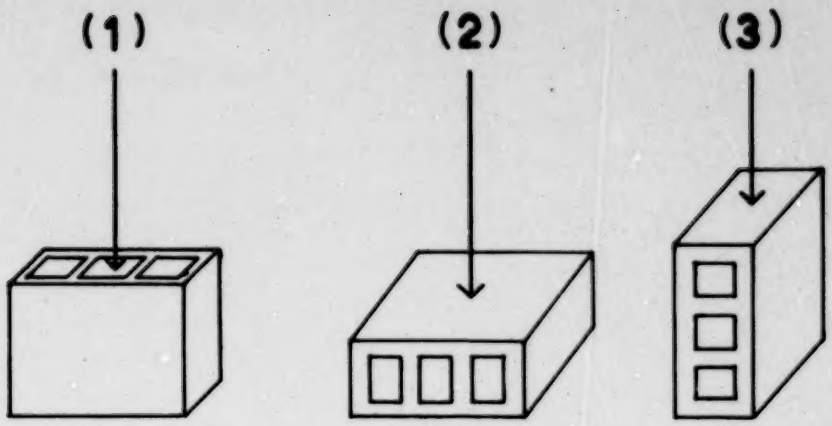
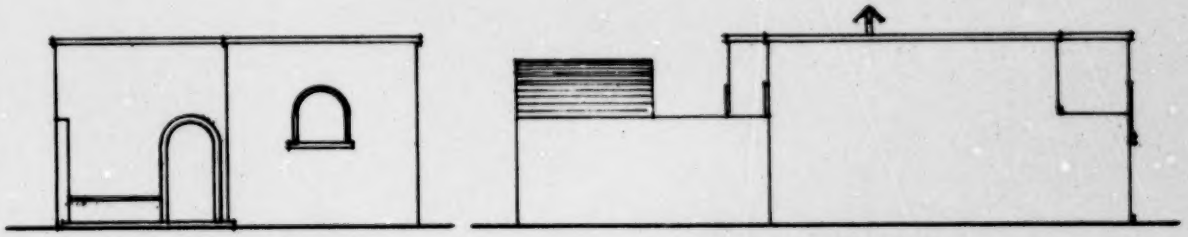
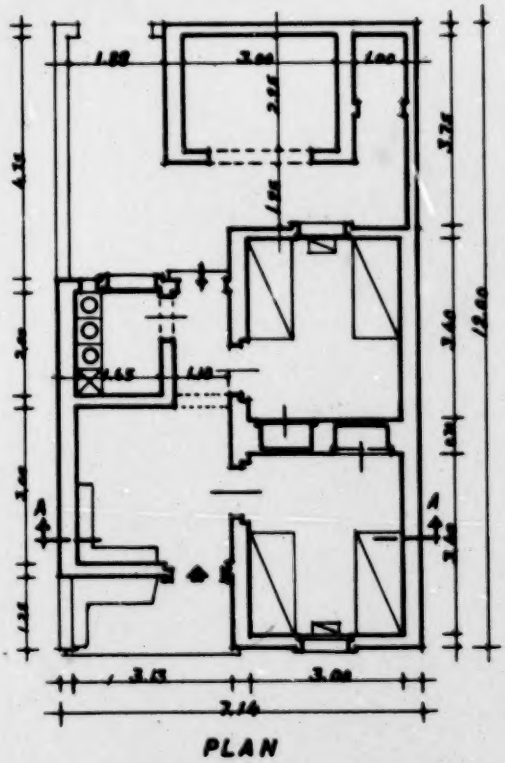


FIG. I

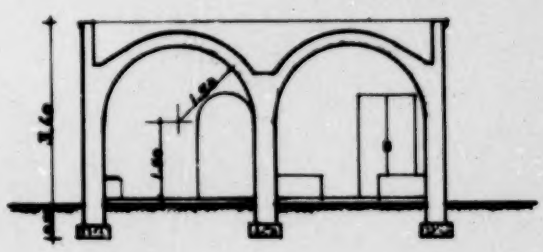


FRONT ELEVATION

SIDE ELEVATION



PLAN



SEC. A - A

LOW COST FARMER'S HOUSE

FIG. II

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E/CONF.39/D/42
SUMMARY
3 Oct. 1962
ORIGINAL : ENGLISH

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
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SUMMARY

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No. 372

LOCAL RAW MATERIALS IN THE PRODUCTION OF GLASS, BRICKS AND TILES IN U.A.R.

D. 13

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SUMMARY

I. GLASS

The modern glass manufacture which started in Egypt in 1932 has been developed since 1952. The total glass production in Egypt in 1961 amounts to about 30,000 tons and is expected to reach 100,000 tons in 1970.

The investigations carried out in the glass - research unit of the National Research Centre, Cairo, made possible the use of local sands in the manufacture of cohite colourless bottles and tableware glass, sheet glass and rolled plate glass in which about 23,000 tons of local sands were used.

Syna sands are suitable, particularly after simple washing with water, for making white colourless glass.

Maadi sand is suitable for making sheet, rolled plate, plate and colourless glass.

Sands from the deserts around Cairo, the deserts between Cairo and Alexandria and Cairo and Suez are suitable for making coloured glass.

As a result of these findings the glass - industry in Egypt will cover in the near future the production of coloured glass for bottles, jars and tableware. The sheet and plate glass production is expected to be doubled and borosilicate and lead oxide-containing glass for optical and decorative (crystal) purposes will be manufactured in 1964 in Cairo.

Possible sources of alkalies(mostly Na_2O) are the sodium sulphate from the rayon industry, felspars and natron from the Natron Valley.

Lime and magnesia are introduced in the form of limestone and dolomite, respectively. The recent discovery of the low-iron magnesite will enable its use in place of imported low-iron dolomite.

Batches for the manufacture of different types of glass such as sheet, rolled plate, plate glass, tableware and bottles are quoted. It is shown that it is possible to melt in one and the same furnace glass suitable for more than one type of glass, e.g., the sheet and plate glass can be made from the same glass composition and similarly for bottles and tableware glass.

II. BRICKS AND TILES

Since ancient times the UAR depends on the Nile silt for brick making. The bricks are of low strength and devoid of good finish due to the non homogenity of the silt raw materials. After the completion of the High Dam at Asswan the major part of the silt will be deposited behind the dam, resulting in a serious shortage of the building industry only source of raw material. They use about eight million tons of the Nile silt every year.

The possible use of natural raw materials to replace the Nile silt in the brick industry was examined. Clays and sands found in abundant in the UAR, Syria and Libyia were studied by subjecting their mixes to a wide series of technological examination and industrial applications. Their suitability for perforated brick making have been proved by semi-mechanical and mechanical means. They are characterised of good finish, variable colours, light weight, good strength and insulating properties.

Technological studies of the different mechanical forming methods have been demonstrated. Stress is given to produce a bearing wall perforated building unit, as a mean to cut the building costs of the farmer's houses.

A new design for the UAR low cost houses built from such units has been claimed.

S - 372 E - Oct.1962 - 1,600

E/CONF.39/D/43
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D. 4

United Arab Republic

THE PROGRESS IN THE CONSERVATION OF SURPLUS AGRICULTURE AND FISHERY PRODUCTS IN THE UAR

By Abdel Aziz HUSSEIN, Ph. D.,
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THE PROGRESS IN THE CONSERVATION OF SURPLUS AGRICULTURE AND FISHERY PRODUCTS IN THE UAR

No. 424

D.4.

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and

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1. Most if not all agriculture products need to be processed before they are consumed. Food products in particular are consumed all around the year, but they are harvested periodically, therefore they need special treatments to extend their marketing period and to prevent their spoilage. Thus the application of storage technics for certain foods is necessary, i.e. grains and meats, fish, vegetables and fruits, that are consumed fresh. In other instances more elaborate technics such as, canning, dehydrating or freezing can extend the life of certain foods for such longer periods.

2. The establishment of food industries, in villages or rural districts have several advantages. Proper processing leads always to the best utilization of existing farm products and also helps to raise crop production by creating new channels for the processed products and thus stimulate farmers to grow more. Proceesing and freezing agricultural products also aids in bettering in nutritional status of the population. The establishment of these new industries in rural districts helps in improving the technical ability of the inhabitants and raises their standard of living.

3. The UAR Government, through the Ministry of Industry, has realised the importance of establishing food industries and hes chosen the localities where raw materials prevail i.e. in villages near farm land and near the sea. The progress in the conservation of food products in the UAR is apparent from the increases in the value of the food industries from 1952 - 1961 which was 122.3 and 170.1 million pounds respectively. This progress is also exemplified by the recent establishment of various modern food processing plants and resulting increase in conserved food production.

4. Modern plants have been established for, canning of fruits and vegetables, fish canning, onion dehydration, shrimp freezing, milk processing, bulk storing, grain silos, cold storage warehouses.

5. In 1961 a general organization for food industries was formed. This organization encompasses all food processing companies. It will certainly direct production of these companies towards much higher levels.

I. Canning of Fruits and Vegetables

6. Seven cannaries are in operation in the UAR of these, two modernally equipped cannaries were established recently. It could be seen (refer to table) that there was a substantial increase in the amount of canned fruits and vegetables during the past en years. The increase was 240% between 1952 and 1961 and 20% between 1952 and 1961.

7. One of the main products canned in the UAR is a type of bean related to Vicia faba. This product is usually consummed as a baked bean dish and is considered one of the typical foods od the country. Many technological problems arise during its canning; the main problem being the baking process which usually occurs in the can during the final heat treatment.

8. Mangoes and pears are the main fruits canned in the UAR although the amounts processed a rather small. Mangoe juice has a lot of possibilities. However technological problems in peeling and juice extraction should be further studied. Several new citrus juice plants are under reconstruction in different localities.

II. Fish Canning

9. Canning of fish mainly sardines, was started for the first time in 1960 with the establishment of a cannary near Damietta. Sardines and other types of fish were usually salted and thus the amount of catch was regulated by the efficiency of small household salting units and by fresh consumption which is limited by insufficient refrigerating facilities. This cannary has certainly stimulated fisherman to increase their catch and will definitely lead to the use of more modern and efficient fishing equipment.

10. The cannary has a capacity to produce 7000 tons of canned sardines, it is also equipped to pack shrimps. The amount of sardines canned in 1961 was 345 tons approximately (refer to table).

III. Onion Dehydration

11. Dehydration of onions is an old established industry in the UAR. Recently a modern plant was opened in Upper Egypt, in the district where onions are one of the main field crops. With the establishment of this cannary the total number of dehydrating plants was brought up to eight with a total production of 5.000 tons of dried onions annually (refer to table).

12. Most of the old plants were in Alexandria and they depended on culls, obtained during the preparation of fresh onion for export, as raw material. The new plant depends on first quality onions grown in Upper Egypt which are especially high in total solids.

13. Other products such as garlic and different vegetables are also dehydrated.

14. Sun drying of certain vegetables such as okra are still produced by primitive means as a Household industry.

IV. Shrimp Freezing

15. Since 1952 five shrimps freezing plants have gone into operation and production has increased five folds since the birth of this industry in 1954.

16. Most of the plants use the Birds' eye system of freezing. The lack of refrigeration in the country directs all of the output for export to the U.S.A. and the European markets.

17. Freezing of other types of fish and vegetables is also carried out however the quantities produced a rather small.

V. Milk Processing

18. Two new milk processing were established in the recent years. The present production of pasteurized milk is about 11.000 tons per year which is well over twice as much as that produced in 1957. (refer to table). Through the efforts of the cooperatives it was possible to supply milk pasteurizing plants with sufficient quantities of cooled milk.

19. Cheese production has also increased in the UAR and a lot of cheese that was imported is now produced locally.

VI. Bulk Storing

20. The lack of adequate storing for grains and other product and the consequent loss by pests and spoilage has pressed the need for establishing a comprehensive plant for storing.

21. A complete project for grain silos and refrigerating units for meats, dressed chickens, fish vegetables and fruits has been laid out.

VII. Grain Silos

22. Three main port silos facilities in Alexandria, Port Said and Safaga which have a total capacity for storing 113.000 tons of grains are planned to be finished between 1960 and 1965. These facilities will serve the whole country through distribution silos in different parts of the country. The distribution silos will have a total storing capacity of 536.000 tons. One of these distribution silos situated at Cairo is now in operation. This facility receives the grain from Alexandria and from the producing districts of the Delta. The silo facility is made up of 49 grain elevators with a total capacity of 58.000 tons and they are equipped to receive automatically 45.000 tons.

VIII. Cold Storage Warehouses

23. The program planned for cold storage warehouses compromises two stages, the first is to be completed by 1963 and includes the construction of 17 units, one in each capital of a governate. Those in Cairo and Alexandria have a capacity of 1500 metric tons each. The others have each a capacity for storing 1100 metric tons. One warehouse in Suez is already in operation; it has a capacity of 1500 metric tons and is now being used for storing imported frozem meats.

24. Potatoes are one of the most important foods that are usually stored under refrigeration in the UAR. They are stored either for seed or for fresh consumption. They have long been stored in primatively ventilated warehouses called "Newala". This method of storing meant an annual loss of 25% of the stored crops.

25. These new cold storage warehouses will certainly help in increasing the storage space for seed potatoes and will reduce the amounts of potatoes lost by spoilage.

Table I gives representative sets of the amounts of some processed foods produced in UAR.

TABLE I
AMOUNTS OF SOME PROCESSED FOODS PRODUCED IN THE UAR

Type of Product	1952	1957	1961
	Amounts produced in tons		
Canned vegetables	1000	2 800	3 419
Canned fruits and juices	--	50	103
Canned sardines	--	--	345
Dehydrated onions	1 600	4 900	4 000
Frozen shrimps	--	300	1 116
Pasteurized milk	--	4 500	10 749
Soft cheese	85 000	77 000	89 863
Hard cheese	2 000	2 000	2 464
Processed cheese	140	400	1 130

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E/CONF.39/D/43
SUMMARY
3 Oct.1962
ORIGINAL : ENGLISH

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SUMMARY

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SUMMARY

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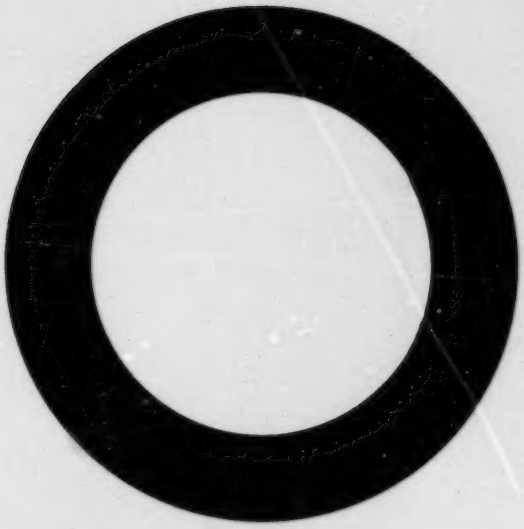

E/CONF.39/D/44
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
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Agenda Item: D.14

United Arab Republic

THE DESIGN OF LOW-COST HOUSING IN RELATION TO LOCAL CONDITIONS

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THE DESIGN OF LOW-COST HOUSING IN RELATION TO LOCAL CONDITION

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1. In almost all countries, efforts are being made for developing housing projects which will suit different social and economic conditions of the people. The crucial problem is how to achieve houses that will suit families whose income does not cope with the number of their members or permit to pay the rent of a suitable dwelling. Some governments have restored to subsidize housing projects for low income groups. But subsidies alone are not adequate, the should be reinforced by other methods for minimizing the construction costs. The following is a presentation of some examples carried out in the U.A.R.

PART I

Case Study: "The redevelopment plan of Port Said"

The Impact of Socioeconomic forces on the location and character of residential developments.

2. The distribution of population in any country is a product of several competitive forces of geographic economic, social and political character Population can be classified into urban, rural-farm, and rural-nonfarm inhabitants according to the place of residence and the nature of work. Cities are social facts of many dimensions. In the field of planning, they are described as moral entities, as products of human history, as a relation between man and his habitat, as a set of economic interrelationships, as centers of political control and as a distinct way of human existance. Those of the same creed, religion, background, race, and income cluster together, usually inside or close to the sectors where their associates gathered.

3. Planners have been holding the hypothesis that there is a strong correlation between spatial and socioeconomic differences in a community. The degree of validity of this hypothesis among the inhabitants of the city of Port Said is the subject of the following discussion.

4. The city lies at the north point of the Suez Canal on the Mediterranean. It was founded in 1868 as a commercial port for maritime navigation and still owes its existance to the operation of the Suez-Canal. Since the creation of the Suez-Canal Company it discriminated in wages and jobs between the natives and foreign employees. Important jobs with very high wages were given to the foreighers while minor posts with relatively much lower wages were given to the natives. Those two cla ses created

another class of population to serve them. Consequently, three classes of inhabitants with distinctive characteristics composed the population of the city. As a result, the city grew into three sectors different in character, the European quarter, Arab quarter N° I and Arab quarter N° II. Table I shows the population of each quarter by nationality.

Table I
Population of Port Said by nationality
(1957)

Quarter	Total	Egyptian	Foreign
European	51572	40320	11252
Arab I	94011	93960	51
Arab II	75998	75998	

5. From this table it can be seen that almost all the foreigners lived in the European Quarter. Although those foreigners were of different nationalities yet, they clustered together owing to similar habits and backgrounds. Because of their high wages they occupied the best location in the city which looked on both the Mediterranean and the Suez-Canal. Their quarter was characterized by low density of population (one person per room) and by high class buildings provided with high standard services and utilities.

6. Native inhabitants represented two categories of population. One comprised those who worked for the ex-company in minor jobs and in jobs related directly to the operation of the canal. The second category encountered the filling part of the population engaged in service activities, fishing, agriculture and related works. The two categories lived in Arab Quarter N°1 and Arab Quarter N° II respectively. Arab Quarter N° I was characterized by middle-class buildings with high density (2 persons per room) and was located next to the European Quarter. Arab Quarter N° II was located to the south of Arab Quarter N° I, it was characterised by very high density (3 persons per room) and the lack of services and utilities, Shaks and wooden houses were the overwhelming majority of the structures therein. Table II shows the distribution of population by occupation in each quarter.

Table II

Distribution of population by occupation in Port-Said excluding children under 5 years (1957)

Classification	Total engaged	European		Arab I		Arab II	
		No engaged	% of total engaged	No engaged	% of total engaged	No engaged	% of total engaged
Agricul., fishing	4009	265	6	1030	25	2714	69
Industrial and Mining	10186	1265	12	5018	50	3903	38

Construction	1769	213	12	906	51	650	37
Transport and Common	10614	1650	15	5234	50	3730	35
Commerce	19960	3516	17	9640	48	6804	35
Private services	70742	13059	18	31821	45	25862	37
P.Services and social work	11368	2740	24	5507	48	3121	28
Undefined	25250	6033	24	1499	51	7718	25
Unemployed	19442	1599	8	9345	48	8498	44
Total	173340	30340		80000		63000	

1. Thefoblowing main observations can be obtained from table II:

(a) The majority of those engaged in low income jobs (agriculture and fishing) reside in Arab Quarter N° II.

(b) The European Quarter had the least percentage of low-wage category and nonemployment.

(c) Arab Quarter I was the place of residence of the majority of those engaged in medium-income jobs.

(d) In each quarter, resided a certain percentage of each occupation.

8. It may be concluded that in general, people of the same kind of work and wage cluster together. However it would appear that social status or prestige, the attitudes and sentiments and the subjective awareness are as important in determining the residential association as family income. This conclusion is evidenced by the intrusion of those engaged in minor jobs into the European quarter as illustrated in table II.

9. In the redevelopment plan of Port Said, due care was given to the location of new housing projects so as to adhere with prevailing socioeconomic forces. A neighbourhood was constructed at Menzalah canal abutting the lake and close to Arab quarter N° I for housing those engaged in fishing and agriculture with economic apartment buildings for low income groups. Another area was appropriated to the south of the city for the construction of a barn enclosure with a small residential tract for those engaged in related activities. Eight neighbourhoods were constructed for medium-income groups near arab quarter N° I, with gross density of 100 persons per acre. Other vacant areas close to the European quarters were appropriated for housing high-income groups. It was provided that the improvement on these areas should be subject to certain conditions in order to

maintain the standards prevailing in their environments. Necessary services and utilities were provided in each of the three classes of residential developments, taking into consideration the needs and the improved standards adopted for their respective occupants.

The Effects of socio-economic forces on the design of the dwelling unit:

10. The design of the dwelling unit is a clear reflection of the social and economic status of its occupants. Social index is affected by the number of family members and the work and education of the family head. Economic status is affected by family and per capita income. After the aggression and its subsequent economic depression in the city of Port Said, economic status was the most important factor for the selection of the dwelling unit. Therefore, in order to conform with the beneficiaries ability to pay, the redevelopment plan of Port Said provided for several designs of dwelling units taking into consideration social factors and the number of family members to a certain extent.

11. For medium income groups, the plan provided free planned apartment buildings with housing units of 2 or 3 rooms, a hall a bath, and a kitchen. For lower income beneficiaries,it provided apartment buildings with housing units of 2 rooms and utilities. For low income groups, raw houses each consisting of one room, a bath,a kitchenette and a yard were provided. In distributing the dwellings, a relation between the rent value and family income was taken into consideration. Also the size of the dwelling was related to the number of members in each family. Due care was given to social association among the beneficiaries. In order to realize the preceding cocepts, the following conditions were required to be fulfilled from applicants:

(a) They should be among those whose homes were destroyed during the aggression.

(b) The applicant should be a head of a family.

(c) The applicant should not own a house in Port-Said or its vicinity.

12. Requests which fulfilled these conditions were considered, giving priority to the following cases:

(a) Families of martyrs who had been living with them in the same dwelling.

(b) Larger families.

(c) Families with low incomes on the condition that their income was not less than 3 times as much as the rent of the dwelling applied for..

13. Table III shows the number of families who had forwarded requests and who fulfilled the preceding requirements.

TABLE III
Distribution of requesting families
(by income and number of members)

Family income brackets each month in Egyptian pounds	Number of Families									Total
	2 persons	3 pers.	4 pers.	5 pers.	6 pers.	7 pers.	8 pers.	9 pers.	10 pers.	
Less than 9	59	73	85	74	67	44	10	11	3	431
over 9 to 12	82	119	142	176	134	109	56	19	20	857
over 12 to 15	53	113	178	159	145	115	104	37	25	929
over 15 to 20	41	101	140	186	181	171	121	71	61	1073
over 20 to 25	30	48	71	96	78	76	60	41	42	542
over 25 to 30	28	32	35	68	41	51	29	28	36	348
over 30	6	16	18	35	29	50	51	30	28	243
TOTAL	299	502	669	794	675	616	416	237	215	4423

The Estimation of Rent:

14. The rent estimated for the dwellings was determined by the size of the dwelling, its location and the advantages possessed by high floors over lower ones. Efforts were made to make the rent value much lower than their commercial value in the market. In order to reach this aim, the government gave great assistance of which are:

(a) Not taking into account the value of the land in the capital on which the estimation was based.

(b) Not including the cost of public utilities in the construction cost.

(c) Setting a long period for capital amortisation.

(d) Not taking any rate of interest on the sums spent for construction, merely an annual unchanging rate of 2% for management, administration and maintenance was decided.

15. From the experience obtained from the execution of the redevelopment plan of Port Said, it was found that some of the beneficiaries had declared false information about their income either to get large size homes or to be eligible to rent a home from the housing authority. Those who declared incomes higher than they had became unable to pay the rent while those who declared lower incomes were crowded in the dwelling unit given to them. It is therefore recommended that better methods for getting real information should be adopted.

The standardization of lots yards, rooms, windows and doors, as an economic necessity:

16. The principle of standardization has been widely advocated in recent years. Several authorities have pointed out its economic benefits. In the following, the standardization of lots, rooms, windows and doors will be discussed with respect to methods of standardization, benefits that can be realized and factors limiting its extensive use.

Standardization of lots and yeards:

17. Almost all developed or developing countries have adopted subdivision regulations, dealing with platting schemes, design of streets, minimum width of lots and the provision of utilities. The requirements of these regulations differ greatly from one place to another according to the standards required for any particular community. Very few countries have provided for zoning ordinances regulating the use of land, height of structures, size of yeards and the built-up area on each lot.

18. In the U.A.R. where no zoning ordinances are adopted, subdivision regulations are supplemented by building codes, which regulate among other things height of buildings and size of yards. Under these regulations and codes which require a minimum width of the lot and relate the size of the yard and its minimum width to the height of building, different standards of buildings with varying legal heights and uses could exist. The inevitable result would be haphazard developments with uncontrolled density of population. Consequently, no related plan-

ning for public utilities and services can be reached, thus impairing the expenditure of the community without corresponding returns. Therefore, the need for controlling density becomes urgent.

19. For help in controlling the density of population in a community, the provision of a zoning ordinance is necessary. But in already grown cities, where different legal uses of land has been scattered without control over a long period of time, it would be very difficult to regulate the use of land by zoning. The standardization of lots and yards in new and developing neighbourhoods is an important tool as well as a means for controlling density.

Methods of standardizing lots and yards:

20. For developing a new residential neighbourhood, social and economic conditions of its prospective residents should be studied. Sectors for those of similar status should be delineated. Based on the previous studies, the size and character of the dwelling units can be determined and the size of lots can be selected. Lots can be standardized in width and depth. Corner lots can be considered special cases to be developed subject to certain conditions. Side, rear and front yards can be fixed to give a certain height according to current building codes. Consequently, the ultimate development of the neighbourhood and the probable future number of people therein can be estimated.

Benefits of standardizing lots and yards:

21. Some of the benefits that can be realized by standardizing lots and yards are listed in the following:

(a) The possibility of estimating potential inhabitants in the planning area, thus helping to prepare an integrated plan for utilities, major thoroughfares and public services in a sound manner.

(b) The even distribution of light and air among the dwelling units which can best be realized by combining standardized yards.

(c) The protection of the improvements on the land against possible deterioration which might result from the incompatibility of different standards of buildings.

(d) The encouragement of dwellers possibly of similar social and economic conditions to cooperate in conserving their neighbourhood against factors of blight.

Factors limiting the use of standardization:

22. Although it appeared that the standardization of lots would be beneficial; there are limitations on its extensive use, some of which are listed in the following:

(a) The repetition of one design or two in a neighbourhood might create monotony, thus adversely affecting its live ability. However, varying elevations with good architectural design would help off set such feeling.

(b) As land requirements for uses other than residential depend on the extent of their respective activities,

sites for these uses cannot be standardized.

Conclusion:

23. From the previous discussion, it can be concluded that the standardization of lots and yards would help in controlling density of population. It would increase the benefits for the occupants and would reduce the expenditures of the community. However it is impractical for uses other than residential.

Standardization of rooms, windows and doors:

24. The standardization of rooms, windows and doors is a means for reducing the construction cost of buildings. Standardization of room sizes would allow for the use of prefabricated materials for building and roofing. A room size can be standardized by designing the width and depth of the room as well as the height of the storey equivalent to the multiplications of prefabricated bricks and slabs. For roofing either by concrete slabs, vaults or dames, necessary forms should be prepared. If the room sizes are standardized these forms can be used several times with the least loss, thus reducing both the time and cost of construction.

25. The standardization of windows and doors also would help to reduce the cost of construction. A central and economic production of doors and windows based on modern technology can be provided for inconvenient locations from which the production can be shipped for use. But it would be much more beneficial if the standards of width and height of the unit comply with the available size of materials. For the purpose of illustration, let us consider that the wooden beams available for making the frames of windows are four meters long. What would be the most economic sizes of windows? To answer this question, an illustration is presented in Table IV, which shows that the

Table IV

Number of frame parts, disposed pieces of beams four meters long

Measures of windows		Parts that can be made		disposed pieces (m)
Width (m)	Height (m)	Horizontal parts	Vertical parts	
1.00	1.00	2	2	-
0.80	1.20	2	2	-
0.70	1.30	2	2	-
1.50	1.00	2	1	-
1.40	1.20	2	1	-
1.00	1.30	1 or 2	1 or 2	0.70 or 0.40
1.20	1.30	1 or 2	1 or 2	0.30 or 0.20

size of the opening whatever it may be can be standardized in a way that the loss of material is eliminated.

Conclusion

26. It can be concluded that the standardization of rooms windows and doors reduces the construction cost of buildings. In selecting the standards, due care should be given to the sizes of building materials available.

PART II

Case Study: "The redevelopment plan of Kena"

The advantages and drawbacks of building by prefabricated materials:

Introduction:

27. On the 20th of December 1954, a heavy rain fell on the hills near the city of Kena, the capital of Kena province. Rainfalls assembled at the bottom of the hills and flooded the city so vehemently that all existing precautions failed to protect the city. As a result, 2830 dwelling units were demolished and 3745 families became homeless. The authority responsible for rehabilitating the city was faced by the problem of housing such number of people in the least time possible. Tents and temporary shleters were immediately provided and a redevelopment plan for the city prepared taking into consideration immediate problems and future needs.

28. One of the main problems that faced the authority was the selection of building materials which would help execute housing projects within their fixed time. A study was made to decide on the suitable materials with due attention given to the ultimate utilization of those existing in the locals. The study revealed so many factors which led the authority to its final decision in this respect. Some of these factors are the subject of the following discussion.

Factors affecting the selection of building materials:

29. In the selection of building materials for housing projects in Kena, there was a number of determinant factors some of which are:

(a) The lack of adequate quantity of red bricks in the locale

(b) The long time necessary for preparing the quantity of red bricks required for the projects

(c) The climatic conditions of the area, characterized by high temperature in spring, summer and autumn seasons

(d) The presence of sand, gravel, pebloles and quarries near the city and the availability ofsample supply of labour force in the locale

(e) The convenience of mud-brick for heat insolation and the unsuitability of using it due to the probability that the area might be flooded again

(f) The question ableness of the results of using stabilized mud-bricks under such conditions and the long time necessary for developing improved production.

30. Considering the previously mentioned factors, and that dwellings should be built in the least time possible, it was decided to use perforated cement bricks and slabs for building and roofing. Elements necessary were abundant in the locale, except the cement which was shipped on the Nile and by rail at low cost. It was found that bricks and slabs could be prefabricated locally. Adequate equipment were transported immediately to the city and sheds and water basins were built on site for the purpose of curing and setting the cement elements. The work was carried on until the projects were completed realizing several advantages which will be discussed in the following:

Advantages of using prefabricated building materials:

31. In the execution of the redevelopment projects of Kena, several benefits were realized, some of which are listed in the following:

(a) An economy in time as the projects were completed in their fixed short time.

(b) The unnecessity of plastering the walls and roofs as the prefabricated materials were shaped in metal forms and had smooth surface.

(c) An economy in the timber necessary for shuttering.

(d) The insolation of heat made possible by the use of prefabricated hollow bricks and slabs.

Drawbacks of using prefabricated building materials:

32. From the experience obtained during the execution of the redevelopment projects of Kena, it was found that using prefabricated materials for building construction had a number of drawbacks some of which are listed in the following:

(a) A reduction in the labour force utilized because of the use of mechanized equipment which in turn resulted in a reduction of the money in-put in the city.

(b) The inadequacy of curing and setting prefabricated materials due to the characteristics of local climate and the short time fixed for construction.

(c) The excess of broken units due to the lack of complete curing and setting.

33. From the previous discussion, it is evident that the economic side of using prefabricated building materials was off-set by the drawback accompanied by their use. The sole important benefit that could be realized was the completion of the projects in a short time.

Conclusion:

34. It can be concluded that the use of prefabricated building materials is beneficial in projects at remote places

and where time factor is more important than economic side. Full prefabrication would be more successful in countries well advanced in industry, and where all mechanical equipment and necessary spare parts are available at a reasonable cost, and where wages are comparatively high and also when the volume of the project, is sufficiently big so as to cover economically the amortisation of the capital invested in the mechanical equipment used in the project. Where normal conditions prevail and where local building materials are avaiable and labour wages are comparatively low, ordinary methods of building become more economical. This conclusion was also reached when examining the tenders of contractors bidding for the housing projects for the reconstruction of Port Said in 1957, since the estimated cost of construction by prefabricated materials was 22% higher than that of building by ordinary methods.

PART III

Case Stuty: School planning in the UAR

Intoduction:

35. Before the advent of the revolution of the UAR in July 1952, there was no plan for the establishment of public buildings. Sometimes, they were centered in main cities and in some cases, they were built according to the influence of those in power. Several governmental authorities were entitled to develop such buildings with no coordination among them. As a result, public buildings were not distributed according to their service areas with respect to location, size or design. In some places, there were more than one building for providing one particular service, while in other places such service was lacking. Before 1952, the average number of school buildings built by the government was five schools per year. These buildings were built so luxurious that the construction cost of the school ranged from L.E. 25000 to L.E. 40000. This small number of school buildings was supplemented by renting structures built for other purposes. The rents were high and the buildings were unsuitable for the purpose they were rented for.

36. After the revolution, the government was faced by such heritage, and furthermore, the demand for more schools to meet the response of people for education, the increase in number of population and the new government policy for fighting against illiteracy. The task which faced the government was great and the budget possibilities were so limited, which led to the creation of a body called the educational building corporation, financed mainly by loans from banks at a low rate interest, thus allowing the investment of large sums of money in building greater number of schools on long pay terms. This body which was created in 1952 and had the objective of building schools only has proved to be successful. Later in 1958 it was charged for the design and execution of other public buildings and its name was changed to The Corporation of Public Buildings. Table V shows the various buildings which have been constructed within the years 1952-1962.

T A B L E V

Number and Distribution of Public Buildings Constructe in 1952 - 1962

Governorates	Ministry of Education		Ministry of Communication	Ministry of Justice	Ministry of Interior	
	Primary schools	Technical & General schools	Offices for Mail, Telephone and Telegraph	Courts Buildings	Polics Stations	Police Units
Middle & North Cairo	98	12	-	-	-	-
South Cairo	66	8	-	-	-	-
Alexandria	64	7	-	1	-	-
Damanhour	55	4	8	6	1	8
Tanta	75	4	11	2	-	1
Kafr El Sheikh	33	2	2	4	1	7
Shebin El Kom	43	4	7	6	-	-
Benha	46	5	9	3	-	1
Mansoura	53	9	14	3	-	10
Damietta	20	1	2	1	1	4
Zagazig	57	6	8	4	1	5
Canal	53	3	-	-	1	2
Giza	64	4	10	3	-	1
Beni Suef	39	2	7	1	-	-
Fayoum	51	7	7	2	-	3
Menia	60	3	15	4	1	2
Assiut	54	4	11	4	-	-
Sohag	39	1	15	5	5	8
Kena	45	4	6	4	2	8
Asswan	19	4	3	1	1	1
TOTAL	1058	94	135	54	14	61

37. The number and distribution of public buildings presented in Table V were based on the real needs taking into consideration the ultimate utilization of existing buildings. For the purpose of illustration, let us consider the case of the city of Cairo. Although its population amounts to about 3.5 millions which is about 12% of the total population at the UAR, its share of school buildings constructed was about 16%, while it had no share of newly constructed public buildings as it had already its needs in that respect.

38. The responsibility of the Corporation was not merely the execution of a number of public buildings. It was also required to reduce the construction cost as much as possible. Following is a brief of the efforts made and the results obtained with this respect.

The reduction of construction cost:

39. Since its creation, the Corporation has exerted every effort possible to construct the buildings at the least cost. Efforts were aimed at the simplification of designs, the selection of suitable building materials, the ultimate utilization of local materials, the determination of size according to the extent of its anticipated use and at the same time improving the standards of the services provided. Specialists of related fields were selected by the Corporation from different departments to carry on the job. Spiritual and material appreciation for those engaged in the work was a good procedure for getting first class work. As a result of the efforts made, the Corporation could built the primary school which is adequate for 500 students within L.E. 11000. Such school comprises 13 classrooms 8 x 5.50, mts., together with necessary rooms, stores and utilities.

40. Methods of building construction followed the characteristics of the locales. Reinforced concrete in skeleton types, bearing walls of red or sand bricks were used in the construction of school buildings. Different designs of schools were prepared to suit any site from the stand point of size and orientation of buildings. The kind, size and position of openings were designed to meet the standards required with respect to the amount and direction of light and air. Desks and tables were made in different designs that suit the age of the students.

41. One main problem has been facing the Corporation, that is the provision of necessary schools and other public buildings in the slum areas of cities. These slums are usually characterized by high density, high cost of land and the presence of old structures. Their clearance projects require a large budget and a long time. The question is whether the Corporation should build the necessary buildings according to the present population or based on the future plans for these slums after being cleared out. If schools are built according to present population, some of them would inevitably be useless after the development of future plans. On the other hand, if they are built according to future population, some of the inhabitants would not be served, otherwise, they have to seek the service

at locations distant from their place of residence. It is recommended however that the number of schools and other public buildings should meet the requirements of the present population. The design of public buildings in excess of those required in the future plans of the slums should be flexible to permit their use for other purposes connected with future development.

419 E - Oct. 1962 - 1,600

E/CONF.39/D/44
SUMMARY
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item:D.14

United Arab Republic

THE DESIGN OF LOW-COST HOUSING IN RELATION TO LOCAL CONDITIONS

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

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THE DESIGN OF LOW-COST HOUSING IN RELATION TO LOCAL CONDITIONS

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SUMMARY

Among most countries, UAR had made great efforts for the development of housing projects and specially to provide low income people with adequate houses at convenient installments through tenancy or ownership.

One of the greatest steps in this direction is the financial assistance of the government for these projects, in addition to the study made for minimizing the construction cost.

PART I

As an example for these efforts is the Redevelopment plan of "Port-Said":

(a) Planning had been done to adhere with socio-economic factors, which led to the redevelopment of three zones, one for the medium income people, the second for fishermen and agricultural people with low income, the third for those engaged in related activities. Each of these three communities had all the necessary services and utilities according to improved standards adopted for their respective occupants. Other vacant areas were appropriated for housing for high income groups.

(b) The design of the dwelling units was affected by the social conditions of the head of the family, his income and the number of his family members. According to these conditions the dwelling units were in the form of apartment buildings composed of 3 or 2 rooms with a hall and utilities for medium income groups, and 2 rooms with a hall and utilities for lower income beneficiaries. For related activities groups, row-houses were provided, composed of one room, a yard and utilities.

In all the dwelling units, special care was put to minimize the cost.

(c) Standardization of lots and yards was adopted, thus a control of the density of the population of the community was achieved. Therefore, utilities and general services had been

adequately provided. Standardization of rooms, windows and doors was also used for reducing the cost of the building and helping the completion in a short time.

(d) Estimation of rent: In order to lower the rent value than the commercial value of the market, the government gave many assistances, namely granting the land, omitting the cost of public utilities and setting a large period for capital amortisation without any interest. To justify the distribution of the dwelling units among the beneficiaries, certain rules had been put to organize the priority.

PART II

The use of prefabricated materials:

The prefabricated materials were used in the redevelopment plan of "Kena". Our observation on this experiment proved that these materials are beneficial in projects at remote places and where time factor is more important than economic side and that full prefabrication would be more successful in countries well advanced in industries.

Thus, we advise that countries which have social conditions similar to UAR would follow, for the time being, the classic ways of construction specially that the wages in such countries are comparatively low, helping in the same time in avoiding non-employment by giving work to more labourers.

PART III

The design of large structure should meet the requirements of their respective service areas in conformity with large range plan

Before the 1952 Revolution there was no public policy for the distribution of public buildings with respect to location. The most obvious example for this case was the ill-distribution and in the same time the lack of schools.

After the revolution the government was faced by such heritage and furthermore the increase of number of population and the new government policy for fighting against illitqracy. This led the government to create the educational buildings corporation, which was charged for planning, design and execution of schools all over the country, giving the care to minimize the cost of construction as much as possible.

The corporation, proving its success in building schools, took further steps in constructing various public buildings. Through this experiment, it was very clear that unifying different types of buildings helped to a great extent in constructing great numbers of these buildings in a relatively short time, moreover it facilitatestechnical supervision considerably and lowers the cost price of the construction, and so we advise to follow the same procedure in any country where large number of type-buildings are needed in a short time.

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